

C. Z. Conclude

the controlling device for transforming the digital signals into pressure values to adjust a relative height between the carrier and the retaining ring.--

REMARKS

Favorable reconsideration of this application, as presently amended, is respectfully requested.

Claims 1, 4-7 and 11 are now active in this application, Claims 1 and 7 having been amended by the present amendment.

This application is a Request for Continued Examination (RCE) of patent application No. 09/741,072. In the Office Action dated April 18, 2001, the specification was objected to because of lack of the necessary reference to the prior applications, and Claims 1, 4-7 and 11 were rejected under 35 U.S.C. §102(e) as being anticipated by Nakashiba et al. (U.S. Patent 5,762,539). In the Advisory Action dated July 20, 2001, the rejection of Claims 1, 4-7 and 11 was maintained and the Examiner suggested that claims directed to an apparatus had to be distinguished from prior art in terms of structure rather than functions.

In response to the objection to the specification, Applicants respectfully traverse the objection. Such an amendment was included in item 17 of the "UTILITY PATENT APPLICATION TRANSMITTAL," which was filed December 21, 2000. Therefore, the objection should be withdrawn.

Amended Claims 1 and 7 are fully supported by the specification, claims and drawings as originally filed. Applicants therefore submit that no new matter has been introduced.

Claim 1 is directed to a wafer polishing head for planarizing a wafer. For example, referring to the non-limiting embodiment of Figs. 2A and 2B, the wafer polishing head includes a carrier 62 for loading the wafer 66, a wafer adhering layer 64 disposed beneath the carrier 62, a retaining ring 72 surrounding the carrier 62, and the wafer adhering layer 64. A first pressure chamber 68 has a first inner pressure disposed above the retaining ring. A second pressure chamber 74 has a second inner pressure disposed on the carrier. A relative height between the retaining ring and the carrier can be adjusted by changing the first and second inner pressure. An automatic control system 90 is respectively coupled to the first pressure chamber and the second pressure chamber for adjusting a relative height between the carrier and the retaining ring. The automatic control system 90 includes a converting device (78 and 92) for transforming the first and second inner pressure into feedback digital signals, and a controlling device 94 coupled to the converting device for comparing the feedback digital signals and producing digital signals from the feedback digital signals. A regulating device is coupled to the controlling device for transforming the digital signals into the pressure values for adjusting fluid pressures in the first and second pressure chambers.

Claim 1 recites a wafer polishing head including a carrier, retaining ring, a first pressure chamber, a second pressure chamber and an automatic control system. By coupling to the first pressure chamber and the second pressure chamber, the automatic control system controls and regulates different pressure inputs to the pressure chambers according to the feedback pressure signals acquired when chemical mechanical polishing (CMP) is performed. Consequently, the relative height between the carrier and the retaining ring is controlled by the relationship between the pressures respectively applied to the first pressure chamber and the second pressure chamber, thereby to improve polishing uniformity.

In Applicants' invention, during the CMP process different pressures in the first and second pressure chambers are adjusted by the automatic control system which processes the pressure values into the digital signals. The digital signals are then compared and output to control and regulate the pressure values in the first and second pressure chambers by the regulators. So, the dynamic response of the relative height between the carrier and the retaining ring can be easily controlled by changing the pressure of the fluid flowing into the first chamber pressure and the second pressure chamber. As a result, the bottom of the retaining ring is frequently maintained lower than that of the carrier, thereby preventing the semiconductor wafer from slipping during the CMP process. The semiconductor can be well protected during polishing and the lifetime of the retaining ring is extended.

Nakashiba et al. disclose an apparatus for and method for polishing work piece. The apparatus includes a top ring 1 for providing a pressing force F1 and a presser ring 3 disposed around the top ring 1 for providing a pressing force F2. The pressing force F1 is adjusted from an air pressure supplied to a top ring air cylinder 10 connected with a part of the top ring 1, while the pressing force F2 is adjusted from an air pressure supplied to the presser ring air cylinder 22 connected with a part of the presser ring 3. By adjusting the pressing force F2 with respect to the pressing force F1, the distribution of polishing pressures is made continuous and uniform from the center of the semiconductor wafer 4 to its peripheral edge and further to the outer circumferential edge of the presser ring 3.

As stated in the Office Action, the top ring air cylinder 10 and the presser ring air cylinder 22 have been cited to teach the first pressure chamber and the second pressure chamber in Applicants' invention. However, the top ring air cylinder 10 and the presser ring air cylinder 22 are regulated respectively by regulators R4 and R5. Nakashiba et al. do not disclose a converting

device for transforming the first and second inner pressure into feedback digital signals, a controlling device coupled to the converting device for comparing the feedback digital signals and producing digital signals from the feedback digital signals, and a regulating device coupled to the controlling device for transforming the digital signals into the pressure values for adjusting fluid pressures in the first and second pressure chambers. Namely, Nakashiba et al. do not disclose any control system for receiving feedback pressure values and processing the feedback pressure values so as to control the pressures in the air cylinders. Accordingly, Nakashiba et al. are not believed in any way to anticipate the specific features recited in Claim 1. Therefore, Claim 1 is believed to be allowable.

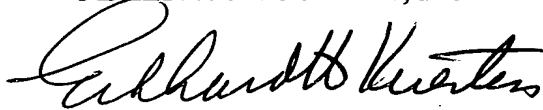
Similarly, Claim 7 recites that the automatic control system includes converting devices for transforming the first and second inner pressures into feedback digital signals, a controlling device coupled to the converting devices for comparing the feedback digital signals and producing digital signals from the feedback digital signals, and regulating devices coupled to the controlling device for transforming the digital signals into pressure values to adjust a relative height between the carrier and the retaining ring. Nakashiba et al. do not disclose such features. Accordingly, Nakashiba et al. are not believed in any way to anticipate the specific features recited in Claim 7. Therefore, Claim 7 is believed to be allowable.

Substantially the same arguments as set forth above with regard to Claims 1 and 7 also apply to dependent Claims 4-6, which depend directly from Claim 1, respectively, and dependent Claim 11, which depends directly from Claim 7. Accordingly, each of the dependent claims is also believed to be allowable.

Consequently, in view of the present amendment, it is respectfully submitted that this application is in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



Gregory J. Maier
Registration No. 25,599
Robert T. Pous
Registration No. 29,099
Attorneys of Record



22850

Tel: (703) 413-3000
Fax: (703) 413-2220
GJM/RTP/MSM:si
I:\user\MSMOR\200690US2RCE.Ame.wpd

Eckhard H. Kuesters
Registration No. 28,870

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RCE Filed on:

Herewith

IN THE CLAIMS

Please amend Claims 1 and 7 as follows:

--1. (Amended) A wafer polishing head for planarizing a wafer, comprising:

a carrier for loading the wafer;

a wafer adhering layer disposed beneath the carrier;

a retaining ring surrounding the carrier and the wafer adhering layer;

a first pressure chamber having a first inner pressure disposed above the retaining ring;

a second pressure chamber having a second inner pressure disposed on the carrier, wherein a relative height between the retaining ring and the carrier can be adjusted by changing the first and second inner pressures; and

an automatic control system respectively coupled to the first pressure chamber and the second pressure chamber [and] for adjusting a relative height between the carrier and the retaining ring, wherein the automatic control system [receives a first feedback pressure signal and transmitted from the first pressure chamber and a second feedback pressure signal and transmitted from the second pressure chamber while a chemical-mechanical polishing process is performed, and the automatic control system respectively transmits a first pressure value and a second pressure value to the first pressure chamber and the second pressure chamber] comprises a converting device for transforming the first and second inner pressures into

feedback digital signals, and a controlling device coupled to the converting device for comparing the feedback digital signals and producing digital signals from the feedback digital signals, and a regulating device coupled to the controlling device for transforming the digital signals into pressure values for adjusting fluid pressures in the first and second pressure chambers.

7. (Amended) A wafer polishing head for planarizing a wafer, comprising:
a carrier for loading the wafer;
a retaining ring surrounding the carrier;
a first pressure chamber having a first inner pressure disposed above the retaining ring;
a second pressure chamber having a second inner pressure disposed on the carrier; and
an automatic control system respectively coupled to the first pressure chamber and the second pressure chamber, the automatic control system comprising converting devices for transforming the first and second inner pressures into feedback digital signals, a controlling device coupled to the converting devices for comparing the feedback digital signals and producing digital signals from the feedback digital signals, and regulating devices coupled to the controlling device for transforming the digital signals into pressure values to adjust a relative height between the carrier and the retaining ring.--